THE REFRACTIVE INDICES OF BLOEDITE[1]

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In the incomplete optical data for bloedite in the older reference books,[2] the refractive index β (the only one listed) is given as 1.500. Apparently the first complete determinations published are those of Stranetzky[3] who in 1907 gave the indices for lithium, sodium, and thallium light for simonyite (synonym for bloedite). Those for sodium light are: $\alpha = 1.4825$, $\beta = 1.4839$, $\gamma = 1.4866$. The axial angle calculated therefrom ($2V = 71°10'$) agrees with earlier measurements. Stranetzky states that γ is the acute bisectrix (ist die erste Mittellinie). From this statement, the mineral would be positive, as is also required by the relative position of β with respect to α and γ. There is no question as to the identity of simonyite with bloedite and as all other determinations give the optical sign of bloedite as negative, there is obviously an error in Stranetzky's determination of β and in his statement that γ is the acute bisectrix. That the mineral is optically negative was verified repeatedly by the writer and by his colleagues C. S. Ross and J. J. Fahey on material from Germany, Estancia Valley, New Mexico, and from San Luis Obispo County, California.[4]

Stranetzky's incorrect determination of β was reproduced in the International Critical Tables[5] although Goergey[6] had called attention to the error of taking γ as the acute bisectrix and had considered Stranetzky's determinations of refractive indices as not usable. However, only his β determination is in error; α and γ are probably correct as they are practically identical with later determinations. Goergey's own values are slightly in error.

In 1910, Goergey[7] gave the following values for sodium light:

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[2] Dana's *System of Mineralogy*, **1892,** p. 947; Groth's *Chemische Krystallographie*, vol. **2,** 1908, p. 506.

[3] Stranetzky, Kajetan, Die optischen Eigenschaften des Simonyt von Hallstadt: *Mineral. u. petrogr. Mitth.*, vol. **26,** p. 144, 1907. The reference is omitted in Appendix II to Dana's *System of Mineralogy*, under bloedite (p. 16).

[4] This bloedite was described by the writer, Large crystals of bloedite: *U. S. Geol. Survey*, Bull. no. **610,** pp. 148–149, 1916.

[5] *Internat. Critical Tables*, vol. VII, **1930,** p. 27.

[6] Goergey, R., Zur Kenntniss der Minerale der Salzlagerstätten: *Mineral. u. petrogr. Mitth.*, vol. **29,** p. 207, 1910.

[7] Goergey, R., *loc. cit.*, p. 207.

$\alpha = 1.486$, $\beta = 1.488$, $\gamma = 1.489$. These values were reproduced by Larsen.[8]

It was noticed in determining the refractive indices of saline minerals from the potash field of New Mexico and Texas, that there seemed to be a decided tendency for the determinations of Goergey to be slightly too high, about 0.003 to 0.004 on the average. Thus Goergey's values for some of the saline minerals are higher than the highest values determined by Schaller and Henderson[9] as follows:

TABLE SHOWING HOW MUCH HIGHER GOERGEY'S DETERMINATIONS OF REFRACTIVE INDICES OF SOME SALINE MINERALS ARE, AS COMPARED WITH THE HIGHEST VALUES DETERMINED BY SCHALLER AND HENDERSON. ALL THE DIFFERENCES GIVEN ARE IN ONE DIRECTION

Mineral	Bull. 833 U.S.G.S. page	α	β	γ
Glauberite	30	.002	.000	.001
Kieserite	41	.003	.004	.003
Langbeinite	43	...	.002	...
Leonite	46	.002	.004	.003
Polyhalite	72	.000	.001	.000
Bischofite	80	.003	.001	.009
Bloedite	80	.005	.005	.005
Thenardite	81	.005	.002	.000

The average difference is 0.003 and if Goergey's values for bloedite be reduced by this correction, they become: $\alpha = 1.483$, $\beta = 1.485$, $\gamma = 1.486$. The reason for Goergey's high values probably lies in his use of such volatile constituents as benzol and alcohol in his immersion oils.

In 1929, Laszkiewicz[10] determined the refractive indices and dispersion for bloedite. His values for sodium light are: $\alpha = 1.4826$,

[8] Larsen, E. S., The microscopic determination of the non-opaque minerals: *U. S. Geol. Survey*, Bull. no. **679**, p. 243, 1921.

[9] Schaller, W. T., and Henderson, E. P., Mineralogy of drill cores from the potash field of New Mexico and Texas: *U. S. Geol. Survey*, Bull. no. **833**, 1932.

[10] Laszkiewicz, A., Bloedite from Kalucz: *Arch. Min. Soc. Sci. Varsovie*, vol. **5**, pp. 79–96, 1929. Abstracted in *Mineral Abstracts*, *Mineral. Mag.*, vol. **22**, p. 334, 1930.

$\beta = 1.4855$, $\gamma = 1.4869$. Schaller and Henderson[11] give the values: $\alpha = 1.481$, $\beta = 1.483$, $\gamma = 1.484$, stating that all indices were below 1.485 and that Goergey's figures are considered to be a little high.

All the values listed, with the exception of those of Stranetzky, agree in that bloedite is optically negative and where given, 2V is close to 71°. The optical properties of bloedite thus seem to be very constant, the slight variations in the third decimal being due to the investigators and not to any variation in the properties of the mineral.

In summarizing the determinations listed, with regard to the critical remarks given, namely that the value of β given by Stranetzky is in error and therefore is omitted and that Goergey's values are 0.003 too high and are lowered that amount, the refractive indices of bloedite are given as follows:

	α	β	γ
Stranetzky	1.4825	.....	1.4866
Goergey (corrected)	1.483	1.485	1.486
Laszkiewicz	1.4826	1.4855	1.4869
Schaller and Henderson	1.481	1.483	1.484

NEW DETERMINATIONS OF THE REFRACTIVE INDICES OF BLOEDITE

	α	β	γ
California Det. by C. S. Ross	1.483	1.486	1.487
California Det. by J. J. Fahey	1.483	1.486	1.487
Artificial Det. by Ross and Fahey	1.483	1.486	1.487
Germany Det. by Schaller	1.483−	1.485+	1.487
New Mexico Det. by Schaller	1.483	1.485+	1.487

[11] Schaller, W. T. and Henderson, E. P., Mineralogy of drill cores from the potash field of New Mexico and Texas: *U. S. Geol. Survey*, Bull. no. **833**, p. 80, 1932.

Obviously, the slightly discordant values given by Schaller and Henderson are about 0.002 to 0.003 too low.

The writer therefore redetermined the indices of refraction of bloedite from Germany and from Estancia Valley, New Mexico, and enlisted the aid of his colleagues C. S. Ross and J. J. Fahey who independently made similar determinations on the bloedite from California and on artificial bloedite. All the determinations were made by the oil immersion method using artificial day light (white light).

Rounding off all determinations to three decimals, using the corrected values of Goergey, and replacing the published values for bloedite, given by Schaller and Henderson, by those just given, the indices of refraction of bloedite are as follows:

REFRACTIVE INDICES OF BLOEDITE

	α	β	γ
Germany, Stranetzky	1.483	.....	1.487
Germany, Goergey	1.483	1.485	1.486
Kalusz, Laszkiewicz	1.483	1.486	1.487
California, Ross	1.483	1.486	1.487
California, Fahey	1.483	1.486	1.487
Germany, Schaller	1.483	1.485	1.487
New Mexico, Schaller	1.483	1.485	1.487
Artificial, Ross and Fahey	1.483	1.486	1.487

The average of these determinations expressed to three decimals give as the refractive indices of bloedite: $\alpha = 1.483$, $\beta = 1.486$, $\gamma = 1.487$. The statement by Schaller and Henderson that all indices are below 1.485 is in error.

As indicated by the determinations of Stranetzky and Laszkiewicz, for sodium light, the α index lies between 1.4825 and 1.4830 and the γ index between 1.4865 and 1.4870. Averaging these two sets of determinations and using only the β value given by Laszkiewicz, the refractive indices for bloedite for sodium light, expressed in four decimals are: $\alpha = 1.4826$, $\beta = 1.4855$, $\gamma = 1.4868$, with an error of probably less than 0.0003.